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EXAMINER	
UHLIR, NIKOLAS J	15
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Please find below and/or attached an Office communication concerning this application or proceeding.

A315

Office Action Summary	Application No. 09/749,473	Applicant(s) IKEDA, HIROYUKI	
	Examiner Nikolas J. Uhlir	Art Unit 1773	

-- The MAILING DATE of this communication appears on the cover she t with the correspondence address --

Peri d for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 22 September 2003 .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1 and 3-14 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1, 3-14 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

1. This office action is in response to the amendment/request for continued examination (RCE) dated 9/22/03. Currently, claims 1 and 3-14 are pending.

Withdrawal of Previous 35 U.S.C 112 Rejection

2. The applicant's amendment to claims 3 and 10-12 is sufficient to overcome the previously applied 35 U.S.C 112 2nd paragraph rejection of these claims. Accordingly, this rejection is withdrawn.

Claim Rejections - 35 USC § 103

3. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

4. Claims 1-7 and 9-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sugita et al. (US4687712) in view of Hokkyo et al. (US6387483), and Michaelsen et al. (US4245008).

5. Claim 1 requires a magnetic recording medium comprising a non-magnetic substrate, at least two soft magnetic layers divided by a separate layer therebetween, each of said at least two soft magnetic layers having a thickness that prevents a non-uniformity of a crystal structure; and at least one magnetic layer formed on the subtrate via the at least two soft magnetic layers, wherein the surface roughness Ra of the medium is at most 50 angstroms, and the product μmax*t of the maximum permeability (μmax) and the thickness (t) is at least 1,000,000 H*a/m.

6. With respect to these limitations, Sugita et al. teaches a vertical (perpendicular) magnetic recording medium comprising a substrate that has been coated with

alternating layers of permalloy and a non-magnetic layer, wherein a vertical magnetic recording medium is deposited on the outermost permalloy layer (column 2, line 65-column 3, line 10). It is well known in the art that Permalloy is a soft magnetic material. Further, Sugita et al. specifically teaches an example, wherein a 50μm thick polymer substrate is coated with a triple layer structure of permalloy/non-magnetic material, wherein the triple layer comprises three 1200 angstrom thick permalloy layers alternately laminated with a Ti interlayer, and a 2000 angstrom thick Co-Cr perpendicular recording layer on the upper permalloy layer (column 5, lines 20-39).

7. Regarding the requirement in claim 1 that the soft magnetic layers have a thickness that prevents non-uniformity of crystal structure. The applicant on page 9, line 21-page 10 line 4 of the instant specification discloses that the thickness of the soft magnetic layer impacts the uniformity of the crystal structure of the soft magnetic layer, with non-uniformity of crystal grains increasing with thickness of the soft magnetic layer, and that this property is manifested by an increase in surface roughness. Further, the applicant discloses on page 13, lines 10-25 of the instant specification that the thickness of the soft magnetic layers is preferably no greater then 4000 angstroms, more preferably no greater than 1500 angstroms, and preferably greater than 100 angstroms, more preferably grater than 300 angstroms. The applicant states that if the soft magnetic layer is too thick, the roughness increases, and if the soft magnetic layer is too thin, adequate yoke effect cannot be obtained. Thus, the examiner takes the position that the specific example cited at column 5, lines 20-38 of Sugita meets the applicants claimed "thickness that prevents non-uniformity of crystal grains" as the this example

utilizes multiple 1200 angstrom permalloy layers, and 1200 angstroms falls completely within the optimum thickness range (300-1500 angstroms) cited in the instant specification as being suitable for use.

8. Regarding the $\mu max*t$ requirement of claim 1. It is noted that Permalloy is well known in the art to be comprised of various NiFe alloys. The applicant admits on page 11 of the specification that NiFe alloys have a μmax of ~330H/m. It is the examiners position that the Permalloy alloy utilized by Sugita will exhibit a μmax of at least this value. Thus, for the example above wherein 3600 angstroms of Permalloy employed, the soft magnetic material will exhibit a $\mu max*t$ of 1152000 H*a/m. Thus, this limitation in claim 1 is met.

9. However, Sugita does not teach a magnetic recording medium wherein the medium has a surface roughness Ra of <50 angstroms, as required by claim 1.

10. With respect to this deficiency, Hokkyo et al. teaches a perpendicular magnetic media that comprises a substrate that has been coated with a thin smoothness control layer, wherein the smoothness control layer is further coated with a soft magnetic layer and the soft magnetic layer is coated with a perpendicular magnetic recording layer (column 2, lines 8-14). Hokkyo states that in perpendicular magnetic recording media, poor surface smoothness of the soft magnetic layer degrades the perpendicular orientation of the perpendicular magnetic layer formed on the soft magnetic layer (column 1, lines 60-67). Hokkyo teaches that adding a smoothness control layer that possesses excellent surface smoothness results in subsequent layers formed on top of the smoothness control layer also exhibiting improved smoothness (column 2, lines 15-

25). Magnetic media with improved surface smoothness exhibit higher recording density, lowered noise, and improved read output voltage (column 2, lines 23-25).

11. Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to add a smoothness control layer as taught by Hokkyo between the substrate and the first soft magnetic layer taught by Sugita et al.

12. One would have been motivated to make this modification due to the teaching in Hokkyo that the smoothness of a magnetic recording medium can be improved through the addition of a smoothness controlling layer between the substrate and a soft magnetic layer in a magnetic recording medium, and that improving the smoothness of the media results in improved recording density, noise, and read output voltage.

13. Further, referring to figures 7 and 8 of Hokkyo, it is clearly shown that the smoothness control layer improves the roughness of the soft magnetic layer, and that there is a strong correlation between the roughness of the magnetic recording layer and the roughness of the soft magnetic underlayer film. Thus, as the smoothness control layer serves to improve the surface roughness of the soft magnetic layer, it necessarily improves the smoothness of the magnetic recording layer (column 10, lines 34-47). More specifically, as the roughness of the smoothness control layer increases, the roughness of subsequent layers increases, whereas if the roughness of the smoothness control layer decreases, the smoothness of subsequent layers also decreases. Thus, the examiner takes the position that the smoothness of the magnetic smoothness control layer is a results effective variable, and it would have been obvious to one of

ordinary skill in the art to optimize the smoothness control layer to be as smooth as possible in order to obtain a magnetic recording layer that is as smooth as possible.

14. Regarding claim 3, wherein the applicant requires the recording medium to have between 2-20 soft magnetic layers, with a separate layer between adjacent soft magnetic layers. This limitation is met as set forth above for claim 1.

15. Regarding claim 4, wherein the applicant requires to total thickness of the soft magnetic layers and the separate layers to be in the range of 500-10,000 angstroms. The example cited above for claim 1 specifically utilizes 1200 angstrom Permalloy layers separated by Ti spacer layers. Though Sugita does not specifically state the thickness of the Ti layers in this example, Sugita teaches that the thickness of the non-magnetic layer must be between 10-500 angstroms (column 3, lines 19-30), and teaches a specific example wherein multiple Permalloy layers are separated by 150 angstrom Ti layers (column 6, lines 20-35).

16. Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to utilize 150 angstrom thick Ti layers in the example cited by Sugita at column 5, lines 20-40, as Sugita teaches that the separator layers must be between 10-500 angstroms thick, and Sugita specifically teaches that 150 angstrom thick TI layers are suitable for separating multiple Permalloy layers.

17. Thus, the limitations of claim 4 are met when three 1200 angstrom thick Permalloy layers and two 150 angstrom thick Ti layers, resulting in the stack having a total thickness of 3800 angstroms.

18. Regarding claims 5 and 6, wherein the applicant requires the ratio of the thickness of the soft magnetic layers to the thickness of the separator layers to be in the rage of 1:0.05-1:0.5, more specifically 1:0.07-1:0.2. This limitation is met as stated above for claim 4, wherein the ratio of total permalloy thickness/total separator thickness is 1/.0833 (3600/300).

19. Regarding claim 7, wherein the applicant requires the separate layers to be non magnetic. This limitation is met by the example stated above for claim 1, which utilize Ti (a known non magnetic) as the material for the separator layers.

20. Regarding claim 9, wherein the applicant requires the thickness of the separator layers to be in the range of 50-300 angstroms, this limitation is met as set forth above for claim 4.

21. Regarding claim 10, wherein the applicant requires the maximum permeability of the soft magnetic material is in the range of 10-1,000,000 H/m. this limitation is met as set forth above for claim 1.

22. Regarding claim 11, wherein the applicant requires the soft magnetic to have coercivity ≤100 oersted. This limitation is met by the example stated above for claim 1, which utilizes Permalloy as the soft magnetic material. Permalloy is known in the art to have a coercivity below 50 oersted, as shown by Michaelsen (column 2, lines 65-68).

23. Regarding claim 12, wherein the applicant requires, the soft magnetic layer to be made of NiFeMo or NiFe alloy. This limitation is met as set forth above for claim 1, as Permalloy is a known NiFe alloy.

24. Regarding claim 13, wherein the applicant requires the medium to be a perpendicular recording medium. This limitation is met as set forth above for claim 1.

25. Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Sugita et al. as modified by Hokkyo et al. and Michaelson as applied to claims 1-7, and 9-13 above, and further in view of Lal et al. (US5834111).

26. Sugita et al. as modified by Hokkyo et al. and Michaelson does not teach a magnetic recording medium that comprise a substrate that has been coated with a plurality of alternating layers of a soft magnetic layer and a separation layer, wherein the separation layer comprises chromium or an alloy containing chromium as the main component, as required by claim 8.

27. However, Lal et al. teaches a magnetic recording medium comprising a substrate, a chromium underlayer formed on the substrate, a multilayer magnetic film comprising 1st and 2nd magnetic layers formed on the chromium underlayer, an isolation layer between the first and second magnetic layers, and a wear resistant over coat (column 1, lines 62-67). The non-magnetic isolation layer is manufactured from one of chromium, titanium, molybdenum, zirconium aluminum, etc.... (Column 4, lines 8-15)

28. Therefore it would have been obvious to one of ordinary skill in art at the time the invention was made to substitute chromium for titanium as the spacer layers in the multilayer magnetic media taught by Sugita et al. as modified by Hokkyo et al. and Michaelson

29. One would have been motivated to make this modification due to the teaching in Lal et al. that titanium and chromium are equivalent materials for use as a spacer layer between two magnetic layers.

30. Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Sugita et al. as modified by Hokkyo et al. and Michaelson as applied to claims 1-7, and 9-13 above, and further in view of Kanbe et al. (US6221508).

31. Sugita et al. as modified by Hokkyo et al. and Michaelson does not teach a magnetic recording apparatus comprising a magnetic recording medium, a driving means to drive the magnetic recording medium in a recording direction, a magnetic head provided with a recording section and a reproducing section, a means to relatively move the magnetic head against the magnetic recording medium, and a recording/reproducing signal treating means to input recording signals to the magnetic head and to output reproducing signals from the magnetic head, wherein the magnetic recording medium is a magnetic recording medium as defined in claim 1, as required by claim 14.

32. However, Kanbe et al. teaches a magnetic storage apparatus that comprises a magnetic head assembly, a head drive unit, a processor unit for processing recording and playback signals from the head, a magnetic medium, and a drive unit for rotation of the magnetic medium (column 6, lines 20-32). The magnetic head comprises a recording and a reading element (column 6, lines 35-37). The magnetic medium is a multilayer magnetic media comprising a substrate, 1 or more underlayers, a recording layer, and a protective layer (column 7, lines 24-49).

33. Therefore it would have been obvious to one with ordinary skill in the art to utilize the magnetic recording medium described by Sugita et al. as modified by Hokkyo et al. and Michaelson in the magnetic recording apparatus described by Kanbe et al.

34. One would have been motivated to utilize the recording media of Sugita et al. as modified by Hokkyo and Michaelson in a recording apparatus such as that described by Kanbe et al. due to the teaching in Kanbe et al. that such an apparatus is suitable for reading and recording magnetic media that comprises at the most basic level a substrate, one or more underlayers, and recording layer, and the teachings in Sugita et al. as modified by Hokkyo et al. of a magnetic recording media that comprises a substrate, multiple underlayers, and a recording layer.

Response to Arguments

35. Applicant's arguments filed 9/22/03 have been fully considered but they are not persuasive. In the instant case the applicants sole argument is that the cited prior art does not teach that the soft magnetic layers have a thickness which prevent non-uniformity of a crystal structure, and thus the applicants have recognized and solved a problem in the prior art. This argument is unpersuasive. The applicant in the instant specification states that the most suitable range of thickness for each individual soft magnetic layer is between 300-1500 angstroms, as set forth above at section 7 of this office action. The prior art explicitly teaches an example wherein multiple soft magnetic layers having a thickness within the applicant's stated optimum range. The applicant has not argued that the claimed non-uniformity in crystal structure is impacte dby any other fact aside from the thickness of the individual soft magnetic layers. Thus, as the

prior art clearly teaches an example utilizing films that have a thickness encompassed by the optimum range elucidated by the instant specification, this argument is not persuasive.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nikolas J. Uhlir whose telephone number is 703-305-0179. The examiner can normally be reached on Mon-Fri 7:30 am - 5 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Paul Thibodeau can be reached on 703-308-2367. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-305-0389.

NJU
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